IMPACT OF THE DEPARTMENT OF DEFENSE SCIENCE AND TECHNOLOGY PROGRAM ON TRAINING AND PERSONNEL SYSTEMS TECHNOLOGY

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OFFICE OF THE UNDER SECRETARY OF DEFENSE
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SUMMARY

The difficulties and costs associated with maintaining a strong and competent U.S. military force have risen significantly during the past decade. In 1981 alone, personnel and related costs will amount to $81 billion; it is projected that this figure will rise to nearly $90 billion in 1982. With the U.S. population supply of 18 year old males expected to shrink by 25 percent in the next 10 years, the Services must continue to maintain a constant active duty force level. The highly sophisticated and complex weapons systems being procured today demand operational and maintenance personnel with highly technical and specialized skills. However, the Services appear to be attracting fewer high quality enlisted personnel now than they did prior to the introduction of the All Volunteer Force in 1973.

The major goal of the Training and Personnel Systems Technology (TPST) program is to increase the Armed Forces' readiness and effectiveness by providing cost-effective solutions to personnel acquisition, training, manpower management and human/weapons system performance problems. Representing less than one-tenth of one percent of the DoD budget, TPST program efforts are a principal element in the overall attack on rising personnel costs. In view of the problems being experienced, the TPST program must be structured to develop those technologies most applicable to future weapons system and personnel needs.

This report reviews all DoD Science and Technology (S&T) exploratory and advanced development programs (less TPST) and identifies the impacts of these programs on the four TPST technology areas -- human factors, simulation and training devices, education and training and manpower and personnel. The report suggests where TPST support to these programs would be appropriate and beneficial. By providing visibility into a wide variety of system and subsystem technology development projects, it serves to identify new application possibilities for existing TPST technology as well as point out research and development needs which may now exist.

Utilizing several different DoD and Service level documents, each S&T Program Element was reviewed to determine its FY 1979 - FY 1986 funding profile, scope of investigation, past accomplishments and future plans. Specific development efforts of relevance to TPST were identified along with their impacts upon TPST technology areas. Potential opportunities for TPST to support or otherwise supplement these development efforts were suggested. Nineteen S&T Program Elements were determined to have major impact upon TPST and these are discussed in the basic report. Appendix A contains a complete review of all S&T Program Elements.

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IMPACT OF THE DEPARTMENT OF DEFENSE SCIENCE AND TECHNOLOGY PROGRAM ON TRAINING AND PERSONNEL SYSTEMS TECHNOLOGY

I. INTRODUCTION

A. Science and Technology Program

The objective of the Department of Defense (DoD) Science and Technology (S&T) program is to maintain a level of technological supremacy which enables the United States to develop, acquire and maintain the military capabilities needed for national security. The S&T program covers most scientific and engineering disciplines and includes basic research, exploratory and advanced technology development.

From 1965 to 1975, the S&T program budget was relatively stable in actual dollars, but decreased by about 50 percent when inflation is considered. In the last few years, this steady decline in real effort has been arrested and a small but steady real growth achieved. Funding for Fiscal Year (FY) 1981 was $3.2 billion; this represents just over 20 percent of the total DoD Research, Development, Test and Evaluation (RDT&E) request of $16.1 billion.

Current S&T program efforts are establishing the bases for future military systems, equipment and combat capability. The following S&T programs illustrate the diversity of efforts being funded during FY 1981:

- Embedded Computer Software Technology - achieve reductions in the cost, size and weight of command and control and signal processing functions to be incorporated in the next generation of military equipment.
- Adverse Weather Capability Precision Guided Munitions (PGM) - to attain an autonomous adverse weather capability to reduce platform vulnerability.
- Directed Energy - to develop a new class of weapon systems which will revolutionize tactical and strategic capabilities.
- Composite Material Development - for application to aircraft, advanced reentry vehicles, radar antennae, gun mounts, laser mirrors and a variety of other systems and equipment.
- Advanced Aircraft Technology - to increase aircraft stability, maneuverability, performance, survivability and effectiveness while reducing pilot workload, weight and electromagnetic interference hazards.
- Chemical Defense Technology - to assure an adequate defensive posture to survive and operate in a nuclear, biological and chemical environment.

- o Medical Technology - to control infectious diseases, provide for improved combat casualty care and to permit sustained operations in anticipated military environments.

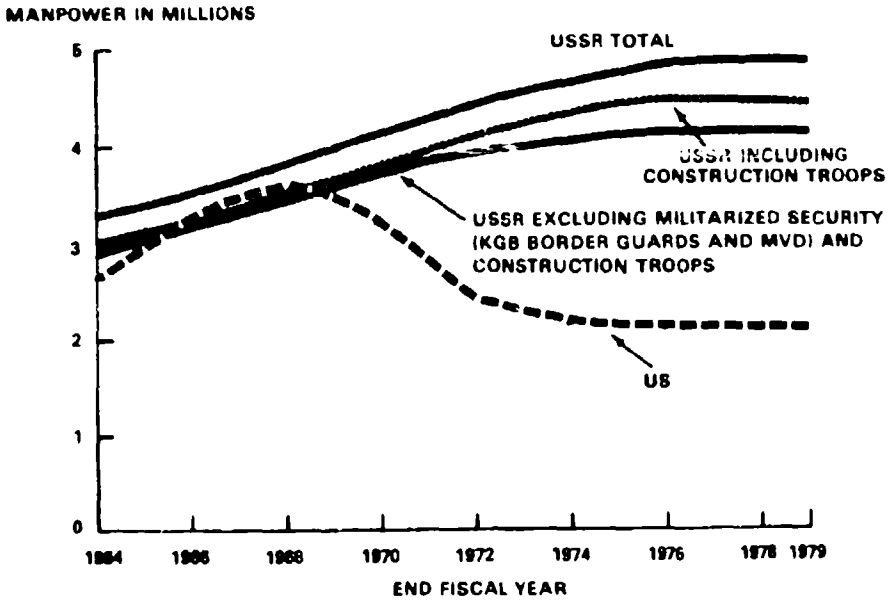
- o Training and Personnel Systems Technology - to improve the efficiency of personnel who operate and maintain military systems and equipment; to compensate successfully for reduced quantity and quality of the career force.

B. The Cost of People

While S&T program efforts are oriented toward the development of future capabilities, they are also rooted firmly in the problems being experienced by the Services today. One problem currently receiving national attention relates to manpower and personnel (quality, quantity and costs). Personnel and related costs are the DoD's largest single budget expense, amounting to $81 billion or approximately 47 percent of the defense budget for FY 1981. From 1974 to 1981, U.S. active duty manpower has remained fairly constant at 2,050,000. Yet in the same time frame, total annual personnel costs have doubled (Figure 1, Tables 1 and 2). Inflation, increases in military pay and compensation and other economic factors will result in a continuation of this trend. As indicated in Figure 2, the number of available 18 year old males will decrease by approximately 25 percent over the next decade while Armed Forces personnel requirements will remain essentially constant. Significant increases in recruiting costs will be experienced as competition for new recruits becomes more difficult.

FIGURE 1

U.S. – U.S.S.R. ACTIVE-DUTY MILITARY MANPOWER



(FROM FY 81 DoD ANNUAL REPORT)

TABLE 1

DEFENSE MANPOWER STRENGTHS
(End Strengths in Thousands)

	ACTUAL				ESTIMATED		
	FY 1974	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983
ACTIVE MILITARY	2,161	2,061	2,025	2,050	2,065	2,094	2,100
CIVILIAN	1,109	991	991	990	994	995	995
SELECTED RESERVE	925	788	807	851	885	923	960

(Sources: DoD Annual Reports, FY 1981 and FY 1982)

FIGURE 2

SUPPLY AND DEMAND FOR YOUNG MEN

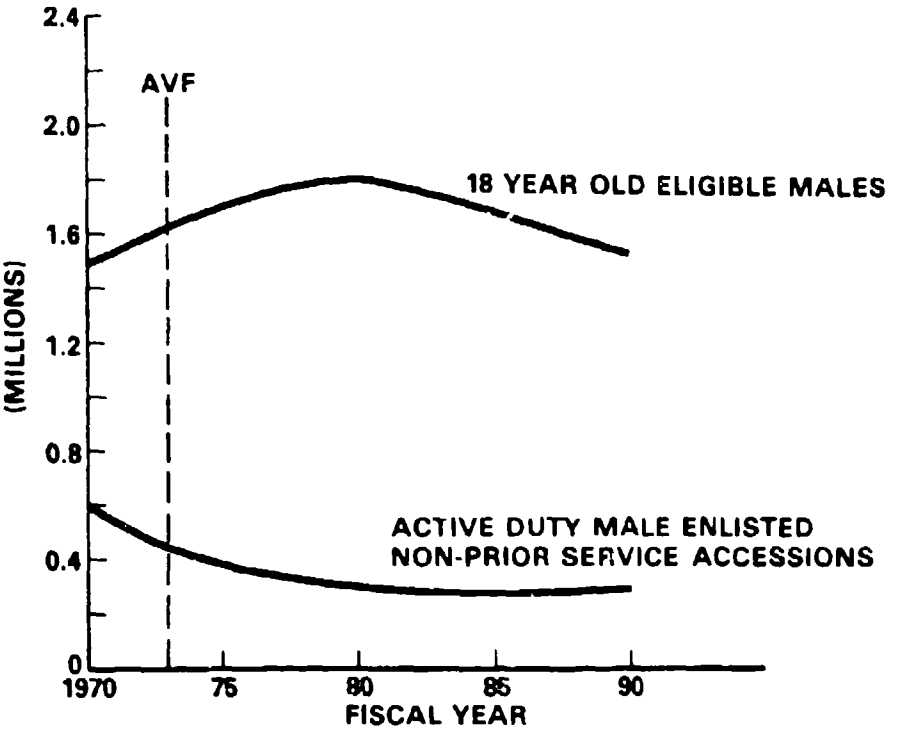


TABLE 2

DEFENSE MANPOWER COSTS 1/
(Outlays in Billions of Current Dollars)

	FY 1974	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982
Manpower Outlays, Military Personnel Appropriations	22.1	25.1	26.3	28.5	33.6	37.5
Defense Family Housing Appropriations 2/	.7	1.1	1.2	1.4	1.5	1.6
Military Retired Pay Appropriations 3/	5.1	9.2	10.3	11.9	13.8	16.0
Reserve/Guard Personnel Appropriations	1.6	2.0	2.1	2.4	3.2	3.2
Civilian Costs 4/	18.9	19.8	19.8	21.4	23.3	24.4
Personnel Support Costs 5/	3.0	4.2	4.8	5.3	5.8	6.3
TOTAL Manpower Costs	46.7	60.5	64.5	70.9	81.2	89.5

Note: Numbers may not add to totals due to founding.

1/ Data exclude civil functions.
2/ Excludes civilian pay portion of this appropriation, which is included under civilian costs.
3/ For those already retired. Future retirement costs for the current force are not currently reflected in the budget.
4/ The cost of civilians is budgeted under the functional appropriation; e.g., operations and maintenance, family housing, RDT&E. Civil Defense pay is excluded in all years.
5/ Preliminary data for FY 1981 and FY 1982. Excludes the direct costs of military and civilian personnel since these are accounted for separately. Includes costs of individual training, medical support, recruiting and examining, overseas dependent education, half of base operating support, and a miscellaneous category.

(Sources: DoD Annual Reports, FY 1981 and FY 1982)

C. Recruiting and Retention

In order to maintain the U.S. active duty force at its present level, between 370,000 and 390,000 new enlisted personnel must be recruited annually. During three of the past four years, the DoD failed to meet its numerical quotas for enlisted personnel. For a number of reasons, including the shrinking supply of eligible young people and changing economic conditions, it is expected that the Services will continue to experience severe recruiting difficulties over the next five to 10 years. (Refs. 4 and 5)

The quality of new recruits is constantly monitored within the DoD; applicant performance on the Armed Service Vocational Aptitude Battery (ASVAB) and percentage of non-prior Service enlisted personnel possessing high school diplomas are two measures of recruit quality for which current data bases are maintained. The ASVAB is used to assess applicants' potential for learning general and specialized military occupations. Formerly, the Armed Forces Qualification Test (AFQT) was used as the sole enlistment elibility criterion. A comparison of AFQT results indicates that mean scores have declined from 52.2 percent in FY 1969 to 46.6 percent in FY 1979 (Figure 3). The decline in percentage of new recruits in the higher mental categories (I and II) is of particular concern since it is these people who are likely to quality for more skill areas and who require less training time. Preliminary data for FY 1980 indicate a continuation of this downward trend in test scores. (Refs. 3 and 12)

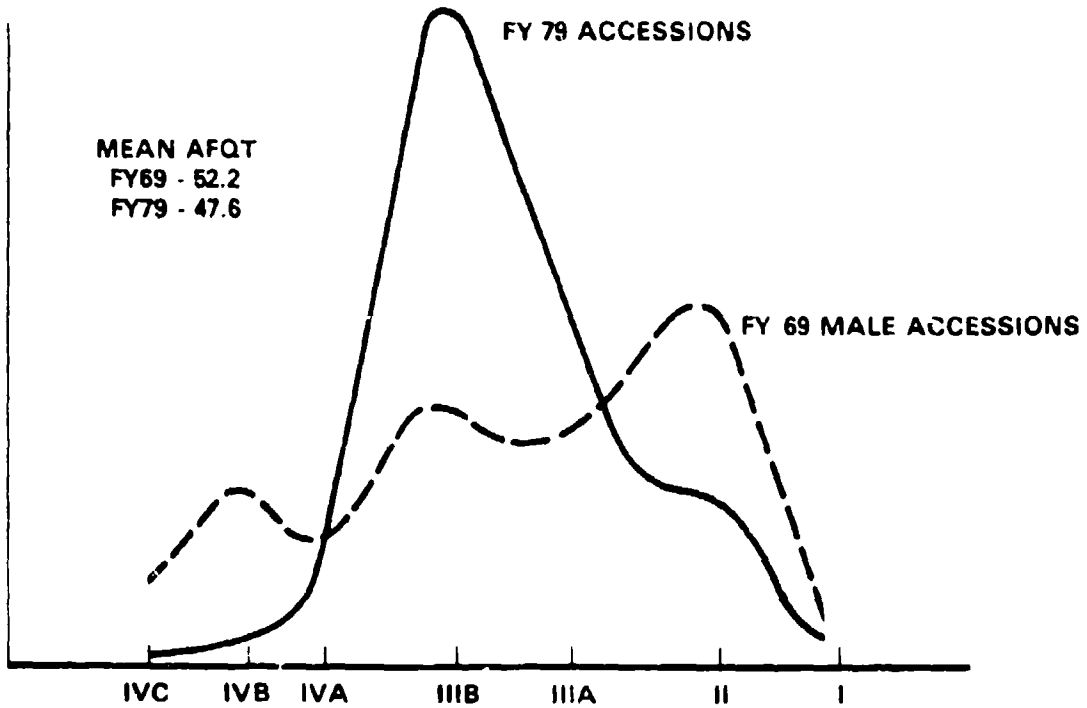
In 1978, approximately 77 percent of all new accessions possessed high school diplomas at the time they entered military service; by 1980, this percentage had fallen to 68 percent (Table 3). The most precipitous decline is being experienced by the Army where the percentage of high school graduates has dropped from 74 percent in 1978 to 54 percent in 1980. In an attempt to reverse these trends indicative of reduced quality, the Congress has imposed certain controls over DoD recruiting criteria, as shown in Table 4. If these controls are effective in raising the quality of Service nonprior accessions, the DoD will have significantly greater difficulty meeting its projected numerical quotas. (Refs. 4 and 5)

In contrast to the comparatively bleak recruiting picture, the DoD retention rate has increased from 25 percent in 1976 to about 35 percent in 1980. With the retention rate at 35 percent, turnover in military personnel remains extremely high. Therefore, it is imperative that new personnel be trained as quickly as possible in order to maximize the amount of time that they are effective on the job. (Ref. 12)

Overall, the Services are acquiring fewer enlisted personnel of high quality and they are remaining for relatively few productive years. This is occurring at a time when the increasing sophistication and complexity of our modern weapons systems demand more operational and maintenance personnel with specialized and highly technical skills.

FIGURE 3

COMPARISON OF FY 1969 AND FY 1979 DISTRIBUTIONS OF ARMY NON-PRIOR SERVICE MALE ACCESSIONS BY MENTAL CATEGORY



FY ACCESSIONS PEAKED AT THE BOTTOM OF MENTAL CATEGORY IIIB WITH NEARLY 63% OF THE TOTAL MALE ACCESSIONS BELOW THE 50th PERCENTILE.

TABLE 3

High School Diploma Graduates as
Proportion of DoD Non-Prior Service Accessions

FY 1974	FY 1975	FY 1976	FY 1977	FY 1978	FY 1979	FY 1980
61	66	69	69	77	73	68

(Source: [illegible] Reports, FY 1981 and FY 1982)

TABLE 4

CONGRESSIONAL CONTROLS ON RECRUITING IN FY 1981 DOD AUTHORIZATION ACT

FISCAL YEAR	MAXIMUM PERCENT CATEGORY IVs*	MINIMUM PERCENT HIGH SCHOOL GRAD
1981	25% DOD AVERAGE	ARMY — 65% (MALES)
1982	25% EACH SERVICE	NO RESTRICTION
1983+	20% EACH SERVICE	NO RESTRICTION

*BASED ON CURRENT TEST CALIBRATION.

(SOURCE: DOD ANNUAL REPORT, FY 1982)

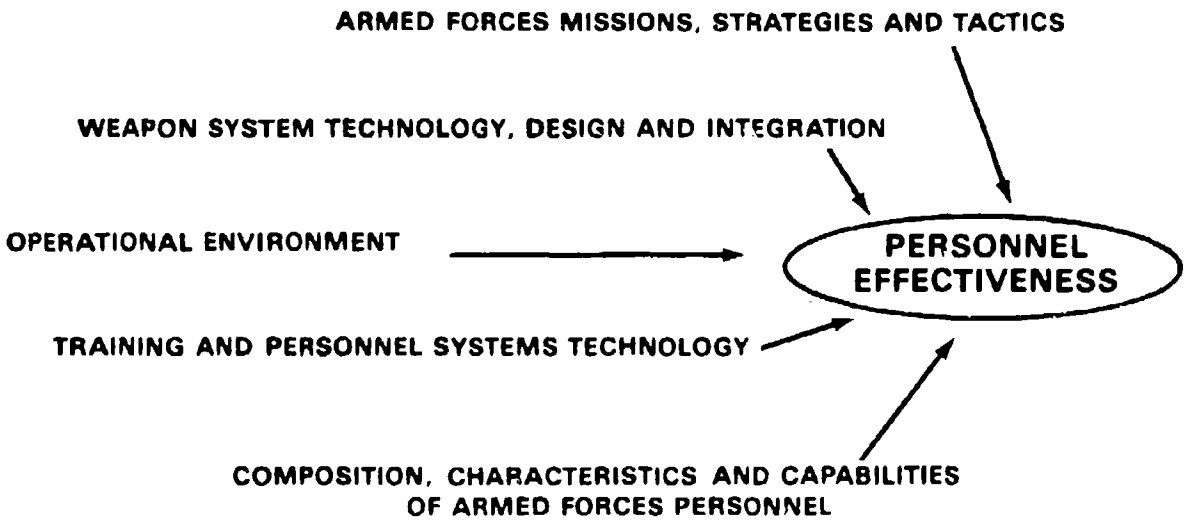
D. The TPST Challenge

The major goal of the Training and Personnel Systems Technology (TPST) program is to increase the Armed Forces' readiness and effectiveness by providing cost-effective solutions to problems of personnel acquisition, training, manpower management and human/weapon system performance. The TPST programs' broad base technology supports basic research, exploratory and advanced development as well as prototype development. Representing approximately eight percent of S&T program funding and less than one-tenth of one percent of the DoD budget, TPST program efforts are a principal element in the overall attack on rising personnel and related costs. Significant research and development challenges exist in each of the four major TPST program areas: Human Factors (HF), Simulation and Training Devices (S&TD), Education and Training (E&T), and Manpower and Personnel (M&P). TPST research and development are receiving priority attention within the DoD; compared to the FY 1980 budget request, the FY 1981 TPST program represents a growth of 40 percent. Accounting for inflation, real growth is 28 percent (calculated in FY 1981 dollars). Notwithstanding this significant growth, the TPST program with its comparatively spartan funding must address itself as effectively as possible to controlling the $81 billion personnel cost in a manner which will yield increased personnel effectiveness.

As indicated in figure 4, TPST is but one of many factors ultimately bearing upon the effectiveness of U.S. military forces. Through the application of TPST to weapon system design and personnel factors, its influence on personnel effectiveness may be greatly enhanced. To maximize its overall contribution, the TPST program must be structured to develop those technologies most applicable to future weapon system and personnel needs.

FIGURE 4

PERSONNEL EFFECTIVENESS



E. Purpose of the Report

This report reviews all S&T exploratory and advanced technology development programs (less TPST), identifies impacts of these programs on the four major TPST areas (HF, S&TD, E&T, M&P) and suggests where TPST support to these programs would be appropriate and beneficial. This information provides a DoD backdrop useful to TPST managers and scientists in formulating research and development strategies and structuring future programs. By providing visibility into a wide variety of system and subsystem development projects, it serves to identify new application possibilities for existing TPST technology as well as point out research and development needs which may now exist. Finally, this report will be useful in identifying opportunities for closer laboratory and Service liaison

Although Basic Research (6.1) and Manufacturing Technology efforts are included in the DoD S&T program, neither is addressed in this report. Basic research efforts were omitted for two reasons. First, the impacts of these programs on TPST will not be realized for many years. Second, many basic research programs are directed toward issues of such a fundamental nature that it is not possible to identify TPST impacts. Manufacturing Technology programs were excluded on the basis that their objectives are to improve manufacturing processes, equipment and methods rather than the actual military product to be operated and maintained by Service personnel.

II. METHOD

A. Approach

An overview of the DoD S&T program was obtained through the Research, Development, Test and Evaluation Technical Area Descriptions (U), dated 1 April 1979. This document provides a well-organized description of the major content areas comprising the S&T program. The basic organization of the TADs was adopted for the present report. Major content areas (or "clusters") and organization are shown in Table 5. Exploratory and Advanced Technology Program Elements were reviewed using the FY 1981 Service RDT&E Congressional Descriptive Summaries (CDS) and FY 1982 Program Objectives Memoranda (POM). The CDS provided insight into recent program accomplishments and short range plans (FY 1981-1982). The POMs were consulted to discover longer range (FY 1983-1986) goals and objectives.

Each Program Element was reviewed to determine its FY 1979-1986 funding profile, scope of investigation, past accomplishments and future plans. Program Element impacts on TPST were identified along with potential opportunities whereby TPST could support or otherwise complement the effort.

B. TPST Impact and Opportunity

"TPST impact" as used in this report conveys two meanings. The first relates to the effects of a Program Element on the TPST technology program. The second relates to the effects on the Service personnel who will operate and maintain the systems embodying a new technology. A three-way classification scheme was used to indicate the particular TPST area affected, the types of effects and the magnitude of the effects. Table 6 portrays the classification scheme used in this report and the following example illustrates its application.

Suppose that a program exists to develop an advanced land combat vehicle and that, as a part of this program, efforts are planned to identify and resolve certain human engineering problems related to driver accommodation. Also, suppose that this new vehicle will require three operators while the vehicle it is scheduled to replace on a one-for-one basis requires only two operators. The impacts associated with this progam might be as follows. First, there would be a positive (+), minor impact on HF technology in that human engineering problems concerning driver accommodation would be assessed. Second, there would be a negative (-), moderate impact upon the M&P area (and E&T area) in that additional vehicle operators must be recruited, assigned, transported, housed, paid and trained as the new systems are fielded.

In many cases, the types of impact a program will have on TPST could not be determined. Most programs encounter TPST-related decision points along the course of their maturation and depending upon when and how competently these decisions are made, the new technology or deployed system may have a positive (+) or negative (-) impact. In cases such as this, impact was categorized as unknown (?).

TABLE 5

Science and Technology Program Content (Cluster) Areas

I. COMBAT VEHICLES
- Aeronautical Vehicle Technology
- Aircraft Propulsion Technology
- Land Mobility Technology
- Ocean Vehicle Technology

II. MUNITIONS AND GUIDED WEAPONS
- Tactical Missiles Guidance and Control Technology
- Propulsion Technology for Missiles and Space Vehicles
- Torpedoes and Other Undersea Warfare Weaponry Technology
- Guns
- Bombs and Clusters
- Landmines, Landmine Countermeasures and Barriers

III. DIRECTED ENERGY TECHNOLOGY

IV. ELECTRONICS
- Electronic Devices
- Electronic Warfare
- Search and Surveillance
- Target Acquisition and Fire Control

V. INFORMATION PROCESSING AND DISTRIBUTION
- Communications
- Command and Control Technology
- Information Processsing Technology

VI. ENVIRONMENTAL AND LIFE SCIENCES
- Chemical Warfare and Chemical Biological Defense Research and Development
- Environmental Sciences
- Environmental Quality Research and Development
- Training and Personnel Systems Technology
- Medical and Life Sciences

VII. MATERIALS AND STRUCTURES

TABLE 6

TPST Impact Categories

TPST Area	Type of Impact	Level of Impact
HF	Positive (+)	Major
S&TD	Negative (-)	Moderate
E&T	Unknown (?)	Minor
M&P		None

The chance for TPST to influence the final outcome of a technology development program is referred to as "TPST Opportunity." TPST opportunities are categorized as "significant," "limited" or "none." As an example, suppose that a new weapon technology is being developed which will lead to the replacement of all radar-directed guns. This advanced weapon system might require maintenance personnel with new skills and knowledge. "TPST Opportunity" might exist to impact the initial design concepts in order to minimize these new skill requirements. "TPST Opportunity" might also exist to ensure that the most appropriate and cost-effective training and simulation technology is applied to maximize overall weapon system availability and performance.

C. Program Element Worksheet

As Program Elements were reviewed, a worksheet was developed for each as shown in Figure 5. The initial entries on the worksheet present the Program Element number and title. In many cases it was found that efforts conducted under a single Program Element fall into two or more content areas. For example, a Program Element in missile technology may include work in areas of Aeronautical Vehicle Technology, Propulsion Technology for Missiles and Space Vehicles, Target Acquisition and Fire Control, and Materials and Structures. In cases where this situation occurred, one of two approaches was taken. Where clear differentiation was possible (e.g., content, funding), portions were separated and presented under appropriate content areas. Where differentiation was not possible, the Program Element was analyzed in full under one content area and referenced in the related content areas.

The next part of the worksheet presents funding information for the period FY 1979 through FY 1986. The CDS was used as the source document for FY 1979 and FY 1980 actual dollars while the Service POMs were used to obtain funding estimates for FY 1981 through FY 1986. On most worksheets, CDS and POM funding data appear as a combined source entry. In cases where a complete Program Element is presented on a single worksheet, the source entry appears as "CDS/POM82(PE)," indicating that the funding applies to the entire Program Element. On worksheets addressing only a portion of a Program Element, two CDS/POM source entries generally appear. The first entry appears as "CDS/POM82" and indicates the level of funding for that portion of the Program Element addressed by the worksheet. The second entry appears as "CDS/POM82(PE)" to indicate funding for the full Program Element. In a few instances where CDS/POM information was not available in usable form, the TADs was used as a funding source. Since the quality of TADs funding estimates were found to be generally inferior to the CDS and POM, the use of the TADs as a funding source was minimized. For worksheets in the Directed Energy Technology area, recent budget estimates from the Office of Under Secretary of Defense for Research and Engineering (OUSDRE) were utilized in preference to more dated CDS/POM figures.

The next portion of the worksheet presents a synopsis of the Program Element (or appropriate portion thereof). Synopsis information was generally obtained from the CDS. Next, program accomplishments and plans are discussed. In this section, information was obtained from CDS and POMs. Depending upon the length of the CDS/POM descriptions and the relevance of the Program Element to TPST, narratives were either repeated verbatim, or edited to include only those efforts with potential TPST relevance. Where efforts were identified as

being related to TPST, they were underscored to lend additional emphasis. Complete CDS/POM narratives are presented where feasible in order to preserve the context within which TPST efforts are being conducted.

The last section of the worksheet deals with TPST impact and consists of a listing of RDT&E efforts relevant to TPST and a narrative discussion. In the RDT&E effort list, the impact of each effort on the four TPST areas is identified as positive, negative or unknown. An asterisk (*) generally appears in the left margin to indicate which effort, if any, was considered to be most significant. In the narrative portion, TPST impact and opportunity are discussed and estimates are presented concerning the level of impact (major, moderate, minor or none) and level of opportunity (significant, limited or none).

Figure 5

Program Element Worksheet Format

PE: XXXXXX XXXXXXXXXXXXXXXXX(Title)
(XXXXXXXXXXXX) (Exceptions, if any)

(U) Funding ($M):	FY 79	FY 80	FY 81	FY 82	FY 83	FY 84	FY 85	FY 86
TADS								
CDS/POM82								
CDS/POM82(PE)								

(U) PE SYNOPSIS: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

(U) FY 1979 and Prior Accomplishments: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(U) FY 1980 Program: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(U) FY 1981 Planned Program: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(U) FY 1982 Planned Program: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(U) TPST IMPACT:

	RDT&E Effort	HF	S&TD	E&T	M&P
	XXXXXXXXXXXXXXXXXXXXXXXX	+	+		
*	XXXXXXXXXXXXXXXXXXXXXXXX		?	-	
	XXXXXXXXXXXXXXXXXXXXXXXX				?

(U) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

III. RESULTS AND DISCUSSION

Complete review and analysis of all S&T Program Elements is presented in Appendix A which is organized by major content (or "Cluster") area. Each content area is subdivided into its respective technology sections and each technology section consists of three parts:

- o Broad Objectives - a narrative discussion derived from the TADs.
- o Summary Chart - which presents Program Element numbers arranged by Service, Program Element title, TPST impact and TPST opportunity. The summary charts are useful in identifying TPST impact and opportunities at a glance. MAJOR impact on a TPST area is indicated in the "TPST Impact" column by a solid circle; the type of impact (+, -, or ?) and the level of impact (major, moderate, minor, or none) are also indicated for the TPST area which is most affected. MODERATE/MINOR impact is indicated by open circles; no additional information regarding type or level of impact is presented for these other TPST areas. In the "TPST Opportunity" column, solid circles indicate those TPST areas where significant opportunities exist; open circles indicate where there is a limited opportunity for support.
- o Program Element Worksheets - organized per figure 5 with content as described above.

A. Major Findings

Nineteen S&T Program Elements were identified as having major impacts upon TPST. Exploratory Development programs account for the majority of these impacts (13 programs) while Advanced Technology Development programs account for the remainder. By far, the greatest impacts were determined to be in the Human Factors area; likewise, Human Factors opportunities were found to be most numerous. Table 7 presents a summary of these Program Elements, impacts and opportunities. Table 8 indicates that major TPST impacts occur in five out of the seven S&T content areas.

B. Discussion

This section presents a summary of the 19 Program Elements which were determined to have major impacts upon TPST. The information about each program is limited to a PE synopsis, a list of the program efforts relevant to TPST and a discussion concerning TPST impact and opportunities. (For a complete review of each program, refer to Appendix A.)

1. Combat Vehicles

a. Tank and Automotive Technology, PE 62601A: This Program Element develops ground combat/tactical systems and subsystems which can better operate against the anticipated threat. The program is subdivided into four main areas: mobility (vehicle propulsion systems, suspension systems and related subsystems), systems integration (advanced concepts for future vehicle systems, methods for optimizing total system designs, and examination of new design/design optimization techniques), survivability (protection against enemy

TABLE 7

PROGRAM ELEMENTS WITH THE GREATEST IMPACT ON TPST

SERVICE	PROGRAM ELEMENT	SHORT TITLE	TPST IMPACT					TPST OPPORTUNITY			
			HF	S&TD	E&T	M&P	TYPE	HF	S&TD	E&T	M&P
ARMY	62202A	AVIONICS TECHNOLOGY	●		○	○	?	●		○	
	62723A	CLOTHING/ EQUIP./SHELTER	●		○	○	?	●		○	
	62307A	LASER WEAPON TECH.	○	○	●	●	–	●	○	●	●
	62601A	TANK AND AUTOMOTIVE TECH.	●	○	○	○	?	●		○	○
	62772A	COMBAT CASUALTY TREAT. TECH.	○		○	●	+				
	63207A	A/C AVIONICS EQUIP.	●	○	○		?	●			
	63209A	AIR MOBILITY SUPPORT	●		○		?	●			
	63602A	ADV. LAND MOBILITY TECH.	●	○	○		?	●		○	○
	63710A	ADV. NIGHT VISION DEVICES	○		●		–	●	○	●	
NAVY	62543N	SHIPS, SUBS AND BOATS TECH.	●		○	○	?	●			●
	62711N	UNDERSEA TGT. SURVEILLANCE	●	○	○	○	?	●		○	
	62721N	COMMAND AND CONTROL TECH.	●	○	○	○	?	●		○	○
	62736N	HIGH ENERGY LASER TECH.	○	○	●	●	–	●	○	●	●
	62758N	BIOMEDICAL TECHNOLOGY	●		○	○	?	●			
	63202N	AVIONICS	●	○	○	○	?	●	○	●	○
AF	62202F	AEROSPACE BIOTECHNOLOGY	●	○	○	○	?	●		○	
	62204F	AEROSPACE AVIONICS	●	○	○		?	●		○	
	62601F	ADVANCED WEAPONS	○	○	●	●	–	●	○	●	●
	63606F	ADV. RADIATION TECH.	○	○	●	●	–	●	○	●	●

LEGEND:

TPST Impact
- MAJOR Impact..... ●
- MODERATE/MINOR Impact.... ○

Impact Type
- Positive..... +
- Negative..... –
- Unknown.... ?

TPST Opportunity
- Significant..... ●
- Limited..... ○

Table 8

SCIENCE AND TECHNOLOGY PROGRAM IMPACT ON TPST
BY CONTENT (CLUSTER) AREA

S&T CONTENT AREA	PROGRAM ELEMENT	SHORT TITLE
COMBAT VEHICLES	62601A	Tank & Automotive Technology
	63209A	Air Mobility Support
	63602A	Adv. Land Mobility Systems Concepts
	62543N	Ships, Subs. & Boats Technology
DIRECTED ENERGY TECHNOLOGY	62307A	Laser Weapon Technology
	62735N	High Energy Laser Technology
	62601F	Advanced Weapons
	63605F	Advanced Radiation Weapons
ELECTRONICS	63710A	Night Vision Adv. Development
	62711N	Undersea Target Surveillance
INFORMATION PROCESSING AND DISTRIBUTION	62202A	Avionics Technology
	63207A	Aircraft Avionics Equipment
	62721N	Command & Control Technology
	63202N	Avionics
	62204F	Aerospace Avionics
ENVIRONMENTAL AND LIFE SCIENCES	62723A	Clothing/Equipment/Shelter Technology
	62772A	Combat Casualty Treatment Technology
	62758N	Biomedical Technology
	62202F	Aerospace Biotechnology

detection and measures to improve survivability if detected) and support (facets of vehicle design germane only to the tactical vehicle as opposed to combat vehicles). The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Tank and other vehicle development	?		?	?
Vehicle ride comfort/ stability	+			
Vehicle lighting modification	?			
Noise reduction	+			
Adiabatic Engine	?		?	?

The largest opportunity for TSPT involvement is with combat vehicle development. The second largest opportunity is with the adiabatic engine. Although the Congressional Descriptive Summary for this PE failed to include human factors as a related activity it was noted that TPST PE 62716A addresses similar content areas. The adiabatic engine may offer reduced M&P and E&T demand in that no cooling system is required; however, the impact of ceramic technology is not known. The TADs recommends that crew trainability be a major consideration in future combat vehicle design; however, this was not mentioned in the Program Element description. Broad applicability of results account for a TPST impact rating of major. Since many of the RDT&E efforts of relevance to TPST are not scheduled to begin until FY 1983, the opportunity for TPST support appears to be rather limited at this time. New vehicle concept developments should be supported by HF (PE 62716A), E&T and M&P.

b. Air Mobility Support, PE 63209A: The objective of this program is to continue advanced development of conceptual prototypes that allow new items of mission support equipment to enter engineering development. Efforts underway in this program will lead to development of hardware needed to support current and future aircraft systems and to enhance the safety and survivability of the aircrew and aircraft. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Develop ALSE Restraint/Helmet	?			
Develop Improved Lighting System	?			
Develop NBC protective equipment	?		?	
Develop aircrew laser protection	?			
Develop container lift adapter	?			

Human factors evaluation of protection garments, etc. is being performed by the Human Engineering Laboratory (PE 61102A (B74)). Existing HF evaluation expertise could be extented to Aircrew Life Support Equipment (ALSE). HF personnel should be involved in the development of Improved Lighting Systems for Army Aircraft (ILSAA). The rationale for funding ILSAA under the ALSE project is not clear. The development of aircrew Nuclear, Biological and Chemical (NBC) protective equipment will require training support to ensure maximum effectiveness. Overall impact on TPST is considered to be major since results will impact current and future aircraft systems and results could apply to other Services.

c. Advanced Land Mobility Support, PE 63602A: This program encompasses development and evaluation of experimental test bed vehicles incorporating the very latest technologies and innovative concepts. The objective is to increase the mobility and combat effectiveness of future land combat vehicles while decreasing development costs and time. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Experimental Tested Vehicles	?		?	?

The CDS for this PE identified the Human Engineering Laboratory as one of the performing organizations (PE 62716A). TPST efforts conducted in support of new vehicle development could yield positive results. Neither the types of TPST efforts being conducted nor the results of these efforts were identified in the CDS. Impact on TPST is considered to be major and the largest opportunity for TPST involvement is in the HF area.

d. Ships, Submarines and Boats Technology, PE 62543N: This program develops the technology required for naval vehicles and integrates this technology into conceptual vehicle platforms. Areas of investigation include systems analysis, machinery, survivability and silencing, and vehicle handling. The following TPST impacts are identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Develop new ship/sub/boat technologies	?		?	?

Although few of the efforts in this program could be identified as impacting on TPST, this Program Element represents the only technology base research and development having to do with advanced naval vessels. It was selected as a major impact program because of its potential for impacting the TPST area. One project under this program is titled "Habitability, Personnel Protection and Damage Control" (F43-451); although few TPST related efforts are currently being conducted as a part of this project, more TPST empahsis could be added. For example, workspace layout could be addressed and manpower allocation studies could be conducted. The opportunity for TPST to support this program

is extremely large. A concerted effort should be made by TPST personnel to identify specific areas where support could be most benefical and to initiate liaison with appropriate Program Element managers.

2. Directed Energy Technology

a. Laser Weapon Technology, PE 62307A: The overall objective of this program is to develop the High Energy Laser (HEL) technology base to permit future HEL weapon system developments, develop HEL weapon system concepts for viable Army missions, demonstrate the lethality capabilities of HEL systems, and explore the possible utility of unconventional beam technologies such as particle beams. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Develop New Offensive/ Defensive Weapons	?	?	-	-

Major impacts of this technology eventually will be felt in all TPST areas. High Energy Lasers (HEL) will require technicians and maintainers with new skills, knowledge, education and training. Manpower and training requirements will vary according to HEL type. HEL operator skill and task requirements will differ according to HEL/Fire Control System integration and tactics. Simulation and training devices will be required to support these new systems. Advanced technology efforts resulting in prototype/demonstrator weapons should receive HF support (possibly from PE 62716A) beginning in FY 1981. Manpower and Personnel support (possibly from PE 62722A) should be initiated in FY 1982 in the form of studies which address old vs. new technology demands on personnel and training.

b. High Energy Laser Technology, PE 62735N: This program is focused on the development of High Energy Laser technology and the resolution of critical technical issues. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Develop HEL Weapons Technology	?	?	-	-

Major impacts of this technology eventually will be felt in all TPST areas. New skills, knowledge, education and training will be required. Simulation and training devices will be required. Opportunities exist for all TPST areas in the long term.

c. Advanced Weapons, PE 62601F: This program, TPST impacts and opportunities are similar to those in paragraph III.B.2.b. above. (See Appendix A for additional details.)

d. Advanced Radiation Weapons, PE 63605F: (See Appendix A for program details.) TPST impacts and opportunities are similar to those in paragraph III.B.2.b above.

3. Electronics

a. Night Vision Advanced Development, PE 63710A: The objective of this program is to apply recent advances in technology to reduce the life cycle costs and improve the performance of night sights to provide the Army with the necessary improved night and limited visibility fighting ability. The night vision and electro-optic systems developed are to be used by the individual soldier, missile systems, helicopters and combat vehicles. More than 20,000 systems will be required for the Army to meet and counter the threat. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Develop and test new sytems	?	?	?	?

The most significant impact of this program is to give the individual soldier a real capability to fight at night, a capability which should be realized in the mid-1980's. The large number of systems to be procured demands a strong HF support effort (which should be initiated immediately). Additional training will be required in terms of system operation and maintenance; therefore, E&T support should be initiated in the near future. Impact on TPST is considered to be major since: (1) considerable human engineering support will be required to develop night vision systems which are effective and easy to use; (2) training programs must be developed for a large number of personnel; and (3) training programs must be initiated to ensure that large numbers of personnel can work effectively together in night and adverse environments. The impact of this program on TPST is also double-edged. On the one hand, night vision devices will make those tasks presently being performed at night easier and safer. However, night vision devices will also make it possible to do things at night which are not presently feasible. Nighttime operations, with individual soldiers encumbered by night vision devices, will be more difficult than comparable daytime operations.

b. Undersea Target Surveillance, PE 62711N: This program investigates the relevance and technical feasibility of potential solutions to Navy operational needs. The most critical problems being addressed are: the detection, classification and localization of the quiet, deep running submarine at significant ranges; the detection and classification of buried and deep moored mines; and the early detection and classification of deployed undersea weapons. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Develop/test new displays and erator aids	?	?	?	?

It appears a major opportunity for impact will emerge in the FY 1983-1986 timeframe. New displays and operator aids will affect all TPST areas. Additional investigation should be undertaken to identify specific areas where TPST support would be benefical and to initiate liaison with appropriate Program Element managers.

4. Information Processing and Distribution

a. Avionics Technology, PE 62202A: This program explores new ideas, concepts and techniques in aviation electronics. The objective of the program is to determine the feasibility of applying new avionics technology to Army aircraft and related ground equipment. Particular emphasis is placed on helicopter operations and crew workload at night, in adverse weather, and at low-level/nap-of-the-earth (NOE) altitudes. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
Develop display and symbology	?			
*Steep approach/landing tests	?	?	?	
Display/display media studies	?			
Position location reporting system (PLRS) integrated control/display	?			
Develop advanced audio systems	?			
Communications ECCM	?			

A variety of human factors efforts are being conducted under this Program Element. To a large extent, HF studies are being conducted as an integral part of system developments aimed at increasing present flight performance or allowing flight under conditions where safe flying is not presently possible. Other efforts (e.g., wire obstacle warning) will increase flight safety. Control/display/symbology research and development is performed either as a part of associated hardware development projects or separately. Effect of this work on TPST is double-edged. On the one hand, present pilot tasking (e.g., navigation, NOE flight) will be made easier and safer. But, on the other hand, helicopter operations not presently feasible (e.g., decelerating steep approach) will be made possible; this will increase the need for additional pilot training and will introduce more difficult tasks to the pilot. HF support to this PE is extremely important--to ensure that man-machine interfaces are optimized and to facilitate the development of new training techniques and equipment which may be required. Advanced audio systems have the potential for improving team performance. ECCM techniques have the potential to degrade communication quality and therefore should be monitored by HF personnel.

b. Aircraft Avionics Equipment, PE 63207A: Army aircraft must have an improved capability to operate at low-level, NOE altitudes while supporting ground combat forces at night and during adverse weather. This Program Element supports this requirement by providing technology demonstration and advanced development leading to engineering development of avionics and related ground equipment. Emphasis is on the hardware which will provide this capability

through improved navigation and control systems, improved avionics packages, and NOE equipment such as target handoff and sensing systems. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
Flight test digital electronic map	?	?		
Develop Master Monitor Display	?	?		
*Solid state multi-format display	?	?		

As with PE 62202A, this work should result in improved present performance or increased capability. HF support to this PE is mandatory to achieve the best results. The master monitor display work appears reminiscent of efforts funded by Office of Navy Research (JANAIR Program) in the early 1970's. Results of these efforts will have applicability to aircraft in all Services.

c. Command and Control Technology, PE 62721N: This program encompasses the exploratory development support of Navy command and control systems which acquire, process and disseminate the information required by a commander in planning, directing and controlling operations. The technology emerging from the information theory and artificial intelligence research base, coupled with recent advances in computer state-of-the-art and in signal processing techniques, provide a unique opportunity to improve significantly future command and control systems. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
Develop generic C^2 system & manning requirements	?			+
*Develop new C^2 displays	?	?		
Investigate voice as a computer input medium	?	?	?	

The development of new display systems is a continuing effort under this Program Element while other TPST-related work varies from year to year. The generic C^2 system may have application to many different ships; it is noteworthy that manning considerations are included as a factor in this development. It appears as though considerable opportunity exists for TPST support of the display and generic C^2 development efforts. Overall impact on TPST is major due to broad applicability of results.

d. Avionics, PE 63202N: One project under this Program Element is titled "Advanced Integrated Display System." This project develops advanced

cockpit instrumentation and control capabilities. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Adv. Integrated Display Sys.	?	?	?	?

The descriptions of this project found in the CDS and the POM were quite vague. It appears that no funding is provided during FY 1981 for AIDS under this Program Element. The impact on TPST is major in that many advanced VTOL/CTOL aircraft cockpits will be based on AIDS concepts. The potential exists, through the conduct of appropriate experimental investigations, to reduce pilot/crew training and/or manpower requirements for future aircraft. However, no evidence was found that these types of studies are being pursued. The opportunity for TPST support of this project is significant, but it appears as though less TPST support is being utilized than may be appropriate. If AIDS technology is going to have the far-reaching impacts that have been claimed, the TPST advantages associated with the concept must be proven.

e. Aerospace Avionics, PE 62204F: This program develops avionics technology which improves the functions of aerospace vehicle command, control, navigation, penetration, defense, reconnaissance, fire control, and weapon delivery. These improvements will result in better performance, lower life cycle cost, higher reliability, and greater mission effectiveness singly in some developments and in combination in other developments. The objective of Reconnasissance, Navigation, Weapon Delivery and Fire Control Technology efforts is to enable USAF aircraft to accomplish their intended missions at the least cost. Radar and electro-optical components and techniques for air-to-air and air-to-ground weapon delivery and fire control systems are developed to get the firepower to the target. An integral part of developing the hardware to do these jobs effectively at low cost is the development of the software to control hardware and to aid the aircrew in distinguishing targets from non-targets. Major thrusts are technology for automatic target classification, fire control algorithms for improved probability of kill, improved inertial sensors, synthetic aperture radar techniques, fire control algorithms for improved tactical weapon delivery. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
Improve threat missile warning & CM	?			
Develop laser warning system	?			
3-D target classification	?			
A-G integrated avionics config.	?	?	?	
Advanced long-range fire control	?	?	?	
Electronic Terrain Map	?	?		

Terrain fol/avoid. ECCM display	?	?
Advanced wide angle HUD	?	?

These efforts logically fall into four areas: warning systems, target acquisition and identification, fire control, and displays. All of these areas will have major impact on operator/system interface. Most efforts could benefit from TPST support, especially from the HF area.

5. Environmental and Life Sciences

a. Clothing/Equipment/Shelter Technology, PE 62723A: This program is designed to improve human performance, environmental protection, and personal comfort; reduce the weight of soldier's clothing and equipment; upgrade levels of protection against chemical agents, flame, and fragmentation threats; investigate countermeasure sytems that provide camouflage of the individual soldier against detection by electro-optical devices; and explore the use of new materials and designs to protect the eyes against nuclear flash, laser and ballistic threats. Also included are efforts to improve field service equipment, field life support facilities, tactical rigid-wall shelters, and the development of design criteria for field shelters. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
Develop anthropometry data (M/F)	+			
Study human performance in high temp. environment	?			
Develop eye protection techniques	?			
Quantify night sight/camouflage interaction	+			
*Develop CB protective clothing	?			
Develop low IR emmittance clothing	?			+
Develop radar absorbtive clothing	?			
Develop cold weather protective clothing	?			+
*Develop clothing with multiple protective capabilities	?			+

It appears as though a significant effort is being conducted to develop CB protective garments. Current national emphasis on chemical defensive capabilities could lead to accelerated development and field testing of protective equipment. Human factors support (possibly from PE 61102A(B74) or PE 62716A) should be provided to ensure complete evaluation of human performance impacts result-

ing from the new clothing and protective devices. While each new development item should protect the user from a specific environmental element, the longer-term issue appears to rest with multiple threat protection. It is unrealistic to issue CB, IR, radar and cold weather protective clothing to each soldier operating in cold weather. It seems equally unrealistic to believe that anyone would know exactly which one type of protection would be required in any given situation. Ultimately, clothing with multiple protective capabilities must be developed. Overall impact on TPST is considered to be major, due mostly to the potential for increased troop survivability resulting from improved protective clothing. The HF area will benefit from the new anthropometry data and improved understanding of night sight effectiveness. Opportunities exist for TPST support of temperature effects studies (HF) and clothing development (HF and E&T).

b. Combat Casualty Treatment Technology, PE 62772A: This program is responsive to aspects of the modern battlefield which are expected to produce a greater number, severity and dispersion of conventional and non-conventional combat casualties. This program is in part designed to improve field medical care ranging from location and diagnosis, through initial forward resuscitation and treatment, to evaluation and field hospital management. It is also structured to counter death, disability and ineffectiveness resulting from the use of chemical warfare (CW) agents. The program scope includes consideration of the threat of nuclear weapons and requirements for development of means to protect against or mitigate the effects of ionizing radiation. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*General			+	+
Determine behavioral effects	?			

Although this program should have a major effect on manpower retention, little or no opportunity exists for TPST to make significant contributions to the work.

c. Biomedical Technology, PE 62758N: This program is directed toward the protection and improvement of the physical and mental effectiveness of Navy and Marine Corps personnel under all circumstances and in all environments in which naval operations are conducted and to which personnel are exposed. Efforts explore new technologies essential to develop and enhance personnel protective clothing; to prevent disease and injury and maximize recovery from disease and injury; to maintain the enhance personal reliability and performance; to define human response to and tolerance of stressors such as toxic chemicals, non-ionizing radiation, heat, accelerative forces and high-pressure/low-pressure environments. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
*Develop new protective clothing and equipment	?		?	+
Investigate performance effectiveness of personnel	?		?	
Physiological assess. of prot./surv. equip.	?		?	
Investigate voice-mediated aircraft control	?		?	
Develop new survival equip.	?			
Develop thin film comm. system	?			
Develop ejection seat back restraint	?			
Investigate effects of combined stresses	?			

Although development of new protective clothing and equipment was identified above as most significant from a TPST standpoint, several of the efforts may have considerable impact; e.g., the investigation of combined stresses on helicopter and V/STOL operations could result in new aircraft design requirements, and the physiological assessment of protective clothing and equipment could lead to improved design and test requirements. Considerable opportunity exists for TPST to support many of these efforts. Based on a spot-check of one effort (investigate psychological constraints associated with voice-mediated aircraft control), only limited TPST/Medical R&D coordination was found to exist.

d. Aerospace Biotechnology, PE 62202F (Projects 6770, 7231, 7755, 7757, 7930: Biotechnology is the core Air Force program for development of human operator centered technologies required for the development and operation of complex and sophisticated weapons systems. The program is a coordinate matrix of projects aimed at facilitating the role of man in hazardous operations environments and at capitalizing on inherent human capabilities to enhance weapon systems effectiveness. The following TPST impacts were identified:

RDT&E Effort	HF	S&TD	E&T	M&P
Develop windblast injury protect. concepts	?			
Dev. chem. defense plan for air crew protection	?			

*Dev. aircrew workload measures	+	?	?	
Develop high-Q escape concepts	?			
tudy aircrew perf. in accel. environs.	+			
Quantify HF aspects of A/C accident	+		?	?
Dev. adv. accel. protection sys.	?			
Study design factors for voice comm.	?			
Study manning rqmts. for C^3 operators	?			?
Devel. adv. on-board oxygen gen. sys.	?			

Most of the significant RDT&E efforts identified above are being conducted under Project 7930 - Advanced Crew Technology. As stated in USAF POM FY1982, the requirement for this project is: "To develop readiness and optimal use of air and ground crew personnel in operational environments and under mission stress." This requirement is closely related to the requirement for HF research and development; therefore, the efforts conducted under project 7930 should be closely coordinated with appropriate HF work funded under TPST. Results of the aircrew workload measures project and aircraft accident project should be made available to appropriate HF personnel to assist in system design. Results of the aircraft accident project could also benefit E&T and M&P areas in that accident causes related to human characteristics could be identified during aircrew selection or could be counteracted through aircrew training. The overall impact of these projects on TPST is major. The opportunity for TPST support rests primarily with HF.

IV. OBSERVATIONS

Two critical observations were made over the course of this study. Although not centrally related to issues under the management cognizance of Training and Personnel Systems Technology, their importance appeared to warrant mention.

A. Display System Development Efforts Could Benefit From Increased Coordination: A very large number of Program Elements are addressed, in part, to the development, test and evaluation of new displays. An extremely wide variety of applications are being pursued--e.g., aircraft, ships, submarines, land combat vehicles, intelligence systems and command & control systems to mention only a few. Although the emphasis of most projects may be on adapting existing technologies to specific applications (vis-a-vis display technology development), the possibility of duplication of efforts appears to be significant. Table 9 lists selected display R&D efforts for each service. Increased liaison between appropriate technology managers may serve to reduce the possibility of overlap and increase the breadth of result utilization.

B. Personnel Protective Clothing/Equipment Development Efforts Could Benefit From Increased Coordination. Table 10 lists selected efforts for each Service. Primary sponsorship of protection clothing and equipment development efforts appears to lie within the Combat Vehicle Technology and Medical/Life Sciences areas. Other technology areas (such as Chemical Warfare and Chemical Biological Defense Research) also have significant development and evaluation projects underway. In some cases, sponsorship rationale is clear while in other cases it seems rather arbitrary. Increased liaison between appropriate technology sponsors would appear to have three potential benefits:

1. Reduce potential duplication of effort; increase Tri-Service standardization of clothing and equipment.

2. Increase the breadth of result utilization.

3. Smooth the transition of personnel protective clothing and equipments items from exploratory development, through advanced development to final application.

Table 9

SELECTED DISPLAY SYSTEMS R&D EFFORTS BY SERVICE

Service	Program Element	R&D Effort
ARMY	62202A	Develop a solid-state display. Develop a new display for the Position Location Reporting System (PLRS). Conduct display/display media studies.
	62209A	Investigate flightworthy tactical display concepts.
	62617A	Integrate a liquid crystal reticle into a tank thermal sight.
	62705A	Develop a tactical video sunlight-legible display. Develop a transparent flat panel display with map overlay capability.
	62709A	Develop a flat panel display for helicopters.
	62715A	Develop advanced EW displays.
	63207A	Conduct advanced development of a master monitor display. Test a digital electronic map display. Conduct advanced development of a solid-state multi-format display.
	63710A	Develop advanced night vision display systems.
	63742A	Develop cockpit tactical displays for emitter threat data. Develop display/processor for intelligence data. Develop a multi-color display for radar warning.
NAVY	62241N	Develop a helmet-mounted display.
	62542N	Develop advanced nuclear reactor instrumentation.
	62633N	Develop fire control man-machine interface for submarines.
	62711N	Develop and test new operator displays for undersea surveillance.
	63202N	Develop Advanced Integrated Display System (AIDS) for aircraft.
	63203N	Develop integrated flight control/display system for helicopters.

SELECTED DISPLAY SYSTEM R&D EFFORTS BY SERVICE (CONT'D)

	63207N	Develop Naval Environmental Display Systems.
	63712N	Develop new test equipment displays.
	63796N	Develop advanced EW displays.
	64218N	Develop satellite display system.
AF	62201F	Develop simplified cockpit displays.
	62204F	Develop terrain following/avoidance display. Develop/test electronic terrain map for aircraft. Develop/flight test on integrated head-up display.
	63203F	Develop/test a missile launch envelope display.
	63718F	Develop advanced EW systems/displays.
	63743F	Develop advanced EW systems/displays.
	63789F	Develop a ground target location display system.

Table 10

SELECTED LIFE SUPPORT/PROTECTIVE CLOTHING AND EQUIPMENT R&D BY SERVICE

Service	Program Element	R&D Effort
ARMY	62202A	Develop and evaluate CB protective equipment. Develop eye protection techniques. Develop CB protective clothing. Develop radar absorbtive clothing. Develop cold weather protective clothing. Develop clothing with multiple protection capability.
	62777A	Study physiological hazards of crew clothing. Publish criteria for life support equipment.
	63209A	Develop inflatable body and head restraint system. Develop integrated helmet system. Develop aircrew NBC protective equipment. Develop aircrew laser protective devices.
	63721A	Evaluate chemical defense face masks. Evaluate M17 protective mask. Develop aviator respirator. Develop power respirator.
	63747A	Develop improved handwear for soldiers. Develop CVC/Artilleryman helmet. Evaluate design for ballistic eye protection. Evaluate micro-climate cooling system for use with CB clothing. Advanced development of aircrew cold weather clothing and gloves. Evaluate foreign equipment.
NAVY	62241N	Develop advanced restraint systems. Develop fire resistant clothing.
	62758N	Develop new aviator protective clothing and equipment. Develop seat-mounted prototype for combined seat back restraint/survival equipment stowage. Develop cold weather clothing. Develop wet weather clothing.
	62764N	Develop protective mask for shipboard use. Test new joint service protective mask. Verify interoperability of Navy and Marine Corps CB protective equipment.

SELECTED LIFE SUPPORT/PROTECTIVE CLOTHING AND EQUIPMENT R&D BY SERVICE (CONT'D)

	63216N	Develop/test integrated protective system for aircrews. Develop aircrew protective clothing and devices.
	63706N	Develop underwater breathing devices.
	63713N	Study cold water thermal protection. Develop guide for design of cold water thermal protective garments. Develop new diving life support systems.
	63722N	Develop underwater protective clothing and devices.
AF	62202F	Develop windblast injury protection concepts. Develop acceleration protective equipment. Develop on-board oxygen generating system.

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